Brushed DC Motor Full-Bridge Gate Driver

FEATURES

- Single Channel H-bridge Gate Driver
  Drive 2 external P+N MOSFETs
- Wide 5V to 40V Operating Voltage
- Supports 1.8V, 3.3V, 5V Logic Inputs
- PWM Control Interface
- VM Undervoltage Lockout (UVLO)
- Overcurrent Protection (OCP)
- Thermal Shutdown (TSD)
- Small Package and Footprint
  -DFN3x3-10 package

GENERAL DESCRIPTION

TMI8720PD is an H-bridge gate driver that uses 2 external P+N channel MOSFETs. It is mainly used to drive 5.5V to 40V brushed DC motors, and other small machines. There are two logic input terminals, used to control the motor forward, reverse and brake, PWM mode control mode.

The maximum current capacity is up to 10A, support for ultra-low power sleep mode; built-in UVLO, Thermal Shutdown, OCP protection circuit.

The package form of TMI8720PD is DFN3x3-10 package, which complies with ROHS specifications, and the lead frame is 100% lead-free.

APPLICATIONS

- Brushed DC Motors
- Mopping machine
- Massager
- Robots

TYPICAL APPILCATION

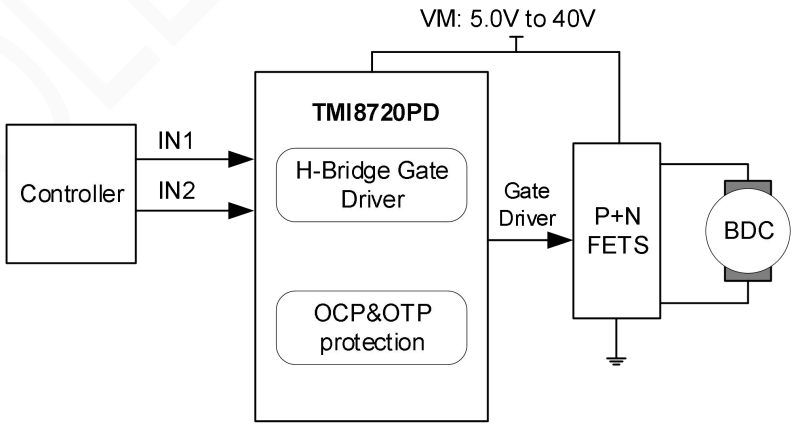
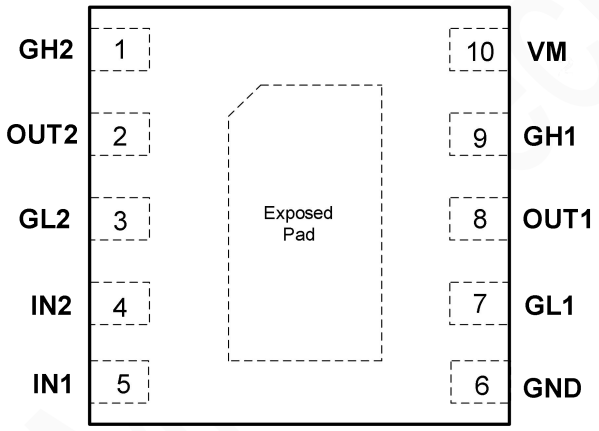


Figure 1. Basic Application Circuit

ABSOLUTE MAXIMUM RATINGS (Note 1)

Parameter	Min	Max	Unit
Power supply voltage (VM)	-0.3	45	V
Logic input voltage (IN1, IN2)	-0.3	7	V
High-side gate pin voltage (GH1, GH2)	-0.3	VM-7	V
Low-side gate pin voltage (GL1, GL2)	-0.3	7	V
Continuous phase node pin voltage (OUT1, OUT2)	-0.3	VM+0.3	V
T_a, Operating ambient temperature	-30	85	°C
Operating junction temperature (Note 2)	-40	150	°C
Storage temperature	-65	150	°C

PACKAGE/ORDER INFORMATION



DFN3x3-10(Top view)

Part Number	Package	Top mark	Quantity/ Reel
TMI8720PD	DFN3x3-10	TMI 8720PD xxxxOH	5000

TMI8720PD device is Pb-free and RoHS compliant.

PIN FUNCTIONS

Pin	Name	Function
1	GH2	High-side gate, Connect to high-side FET gate.
2	OUT2	Connect to high-side FET source and low-side FET drain.
3	GL2	Low-side gate, Connect to low-side FET gate.
4	IN2	Logic inputs. Controls the output. Has internal pulldowns.
5	IN1	Logic inputs. Controls the output. Has internal pulldowns.
6	GND	Logic ground. Connect to board ground.
7	GL1	Connect to high-side FET source and low-side FET drain.
8	OUT1	Low-side gate, Connect to low-side FET gate.
9	GH1	High-side gate, Connect to high-side FET gate.
10	VM	5V to 40V power supply input. Connect a 0.1μF bypass capacitor to ground, as well as a sufficient bulk capacitance rated for VM.
11	GND	Ground Pin (Exposed Pad).

ESD RATING

Items	Description	Value	Unit
V_{ESD}	Human Body Model for all pins	±2000	V

JEDEC specification JS-001

RECOMMENDED OPERATING CONDITIONS

Items	Description	Min	Max	Unit
VM	Power supply voltage range	5	40	V
Logic input	V_{IN_X}	-0.3	6	V
Logic input	F_{IN_X}	0	50	kHz

ELECTRICAL CHARACTERISTICS

T_A = 25°C, over recommended operating conditions unless otherwise noted.)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Power supply (VM)						
Operation voltage	V_{VM}		5		40	V
Shutdown current	I_{VMQ}	VM=24V, IN1=IN2=0V, no load			20	nA
Standby current	I_{VM}	VM=24V, IN1=IN2=5V or IN1=5V & IN2=0V or IN1=0V & IN2=5V, no load	0.4	0.5	0.6	mA
PWM current	I_{VMPWM1}	VM=24V, IN1=5V, IN2=50kHz, no load	1	1.8	3	mA
VM undervoltage lockout	V_{UVLO_fall}	VM falls until UVLO triggers	4.2	4.4	4.5	V
	V_{UVLO_rise}	VM rises until operation recovers	4.5	4.7	4.8	V
Logic inputs						
Input logic high voltage	V_{INH}		1.4		5.5	V
Input logic low voltage	V_{INL}				0.7	V
Input logic high current	I_{INH}	VM=24V, IN_X=5V		50	75	μA
Input logic low current	I_{INL}	VM=24V, IN_X=0V			1	μA
FET GATE DRIVERS (GH1, GH2, GL1, GL2, OUT1, OUT2)						
High-side VGS gate drive (gate-to- source)	V_{GHS}	VM>24V	-5.6	-5.8	-6.0	V
		VM=12V	-5.5	-5.7	-5.8	
		VM=8V	-5.1	-5.2	-5.3	
Low-side VGS gate drive (gate-to- source)	V_{GLS}	VM>24V	5.6	5.8	6.0	V
		VM=12V	5.5	5.7	5.8	
		VM=8V	5.4	5.5	5.6	
High-side Gate Drive current	I_{GHX}	Peak Sink current		50		mA
		Peak Source current		200		
Low-side Gate Drive current	I_{GLX}	Peak Sink current		200		
		Peak Source current		50		
Output dead time	t_{DEAD}	Body diode conducting		300		ns
Output rise time	t_{RISE}	VM=24V, OUTx rising 10% to 90%		165		ns
Output fall time	t_{FALL}	VM=24V, OUTx falling 90% to 10%		150		ns
Input to output propagation delay	t_{PD}			150		ns

ELECTRICAL CHARACTERISTICS (Continued)

T_A = 25°C, over recommended operating conditions unless otherwise noted)

Over temperature protection						
Thermal shutdown	T_{SD} (Note 3)			160		°C
Thermal shutdown hysteresis	T_{HYS} (Note 3)			35		
Over current protection						
$V_{DS(OCP)}$	$V_{DS\_H\text{-}side}$	VM=24V, High side FETs: VM – OUTx		0.38		V
	$V_{DS\_L\text{-}side}$	VM=24V, Low side FETs: OUTx – GND		0.26		V
Overcurrent deglitch time	t_{OCP}			3.5		μs
Overcurrent retry time	t_{RETRY}			2.5		ms

Note 1: Absolute Maximum Ratings are values beyond which the life of devices may be impaired.

Note 2: T_J is calculated from the amIN2ent temperature T_A and power dissipation P_D according to the following formula: $T_J = T_A + P_D \times \theta_{JA}$. The maximum allowable continuous power dissipation at any amIN2ent temperature is calculated by $P_{D\,(MAX)} = (T_{J(MAX)}-T_A)/\theta_{JA}$.

Note 3: Thermal shutdown threshold and hysteresis are guaranteed by design.

OPERATION

Overview

The TMI8720PD is an H-bridge gate driver . The device integrates FET gate drivers in order to control 2 external P+N channel MOSFETs.. The device can be powered with a supply voltage between 5V to 40 V.

Bridge Control

The TMI8720PD output consists of 2 external P+N channel MOSFETs. TMI8720PD that are designed to drive high current. These outputs are controlled by the two logic inputs IN1and IN2 as listed in Table 1.

Table 1. H-Bridge Control

IN1	IN2	OUT1	OUT2	DESCRIPTION
L	L	High-Z	High-Z	Coast; H-bridge disabled to High-Z
L	H	L	H	Reverse (Current OUT2 → OUT1)
H	L	H	L	Forward (Current OUT1 → OUT2)
H	H	L	L	Brake; low-side slow decay

The inputs can be set to static voltages for 100% duty cycle drive, or they can be pulse-width modulated (PWM) for variable motor speed. When the VM voltage is set above the UVLO point and the logic input pins is left floating or connected to logic low voltage, the OUTx is at high

resistance state. The OUTx is connected to GND via the internal N-channel MOSFET once the corresponding Inx is turned logic high.

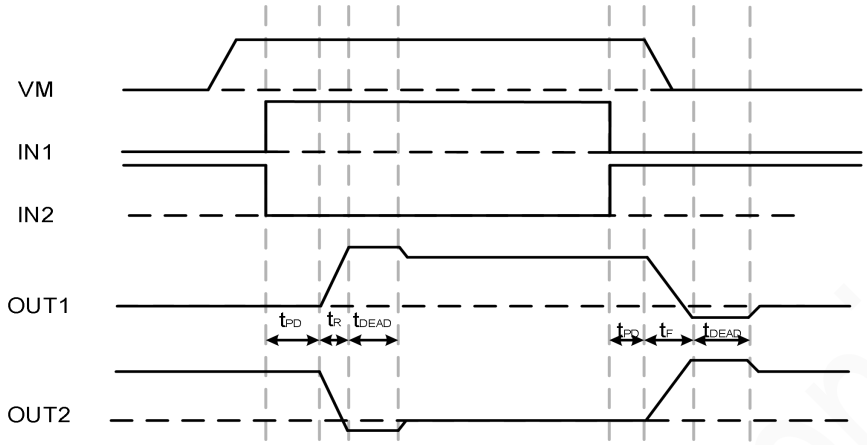


Figure 2. Propagation Delay Time

VM Undervoltage Lockout (UVLO)

If at any time the voltage on the VM pin falls below the undervoltage-lockout threshold voltage, all FETs in the device will be disabled. Operation resumes when VM rises above the UVLO threshold.

Overcurrent Protection (OCP)

If the output current exceeds the OCP threshold, IOCP, for longer than t_{OCP}, all FETs in the device are disabled. After a duration of t_{RETRY}, the MOSFET is re-enabled according to the state of the INx pins. If the overcurrent fault is still present, the cycle repeats; otherwise normal device operation resumes.

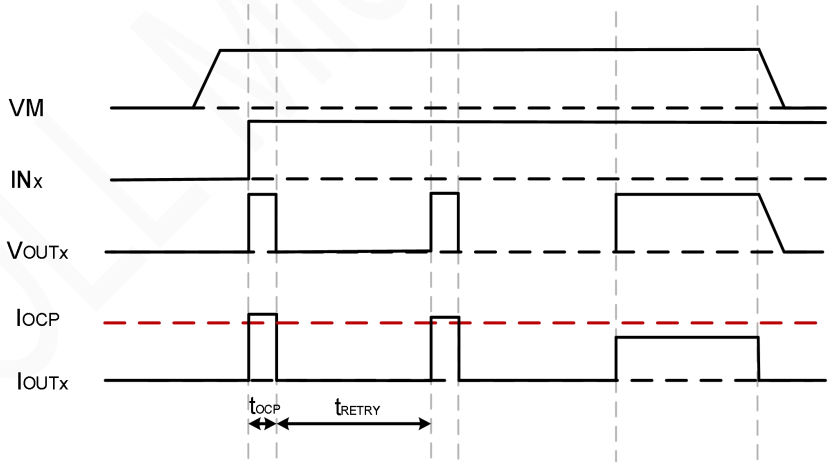


Figure 3. Over current protection Time Periods

Thermal Shutdown (TSD)

If the die temperature exceeds safe limits, all FETs in the device are disabled. After the die temperature has fallen to a safe level, operation automatically resumes.

APPLICATION INFORMATION

The TMI8720PD devices are typically used to drive two directional motors as below:

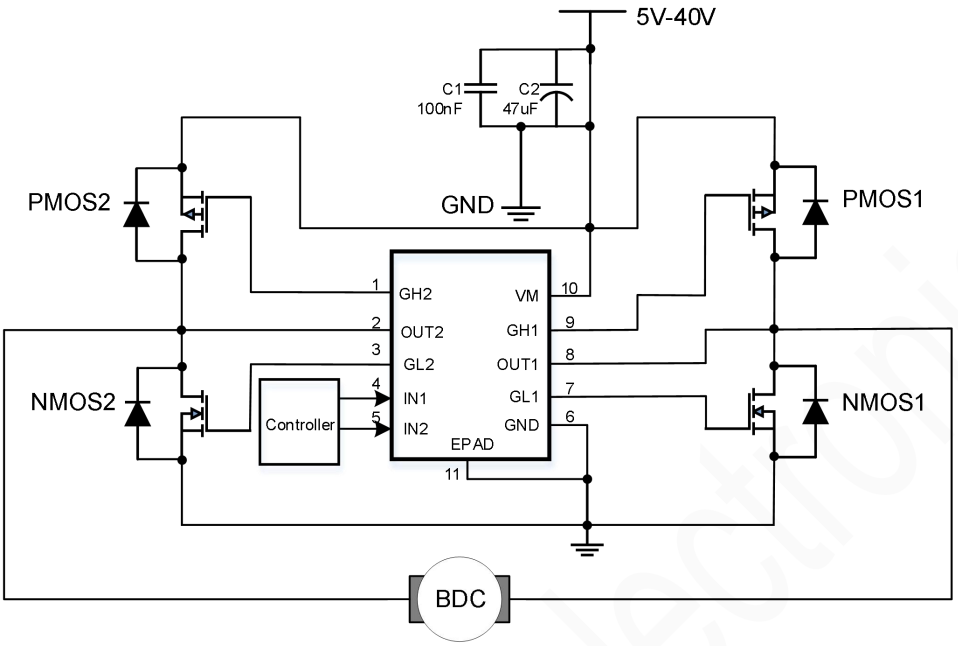


Figure 4. TMI8720PD Typical Application

Block Diagram

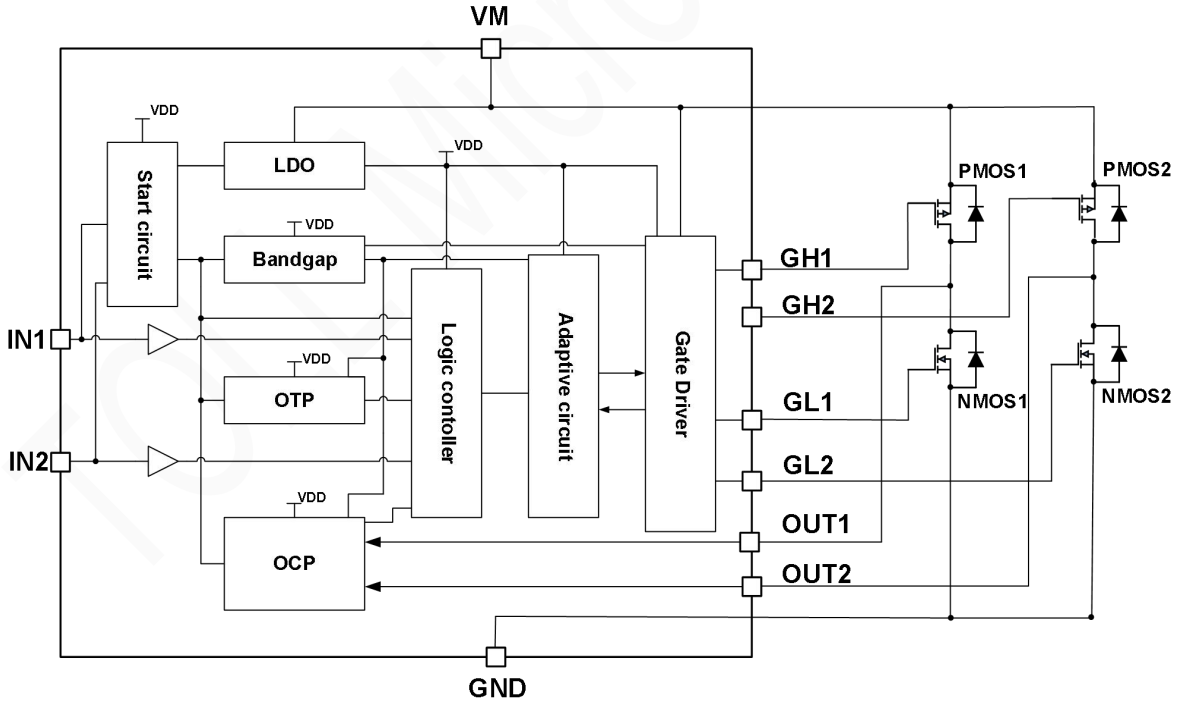
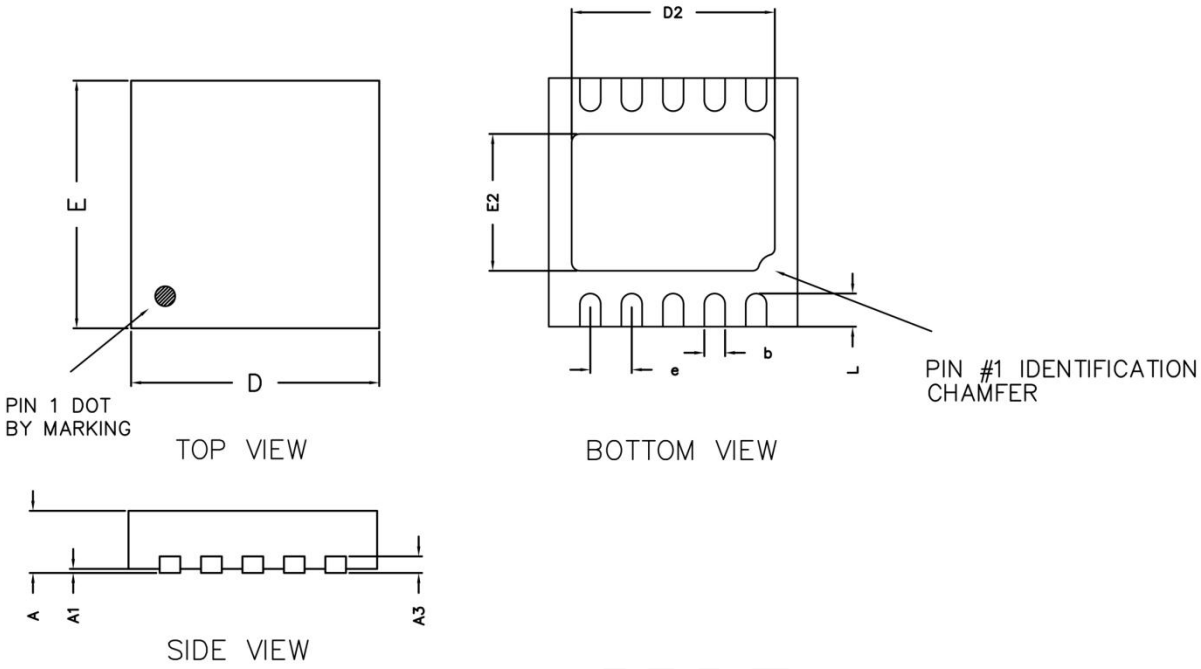


Figure 5. TMI8720PD Block Diagram

Package Information

DFN3x3-10

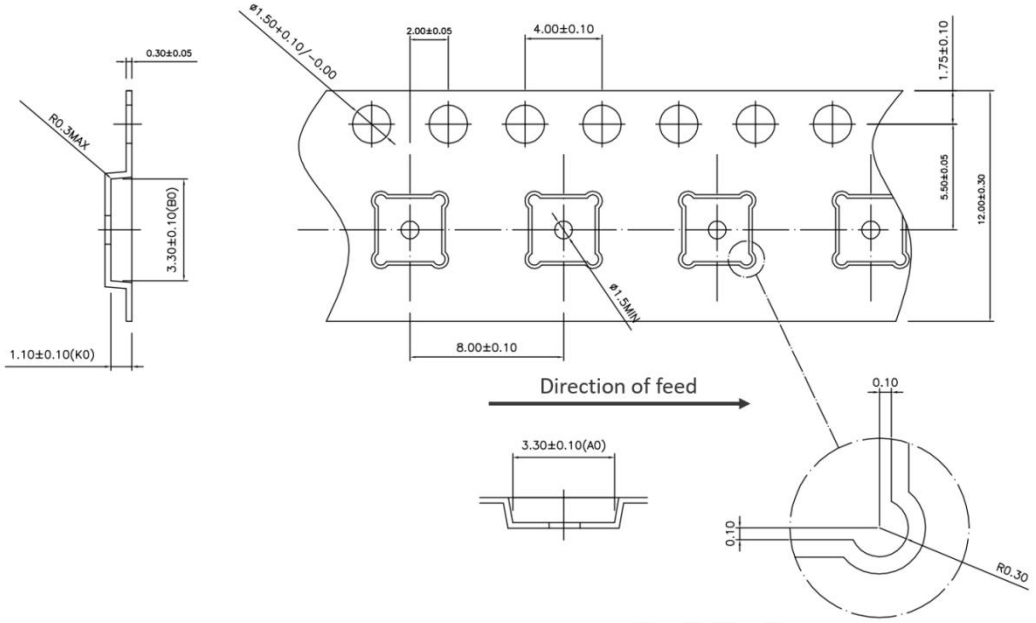


Unit: mm

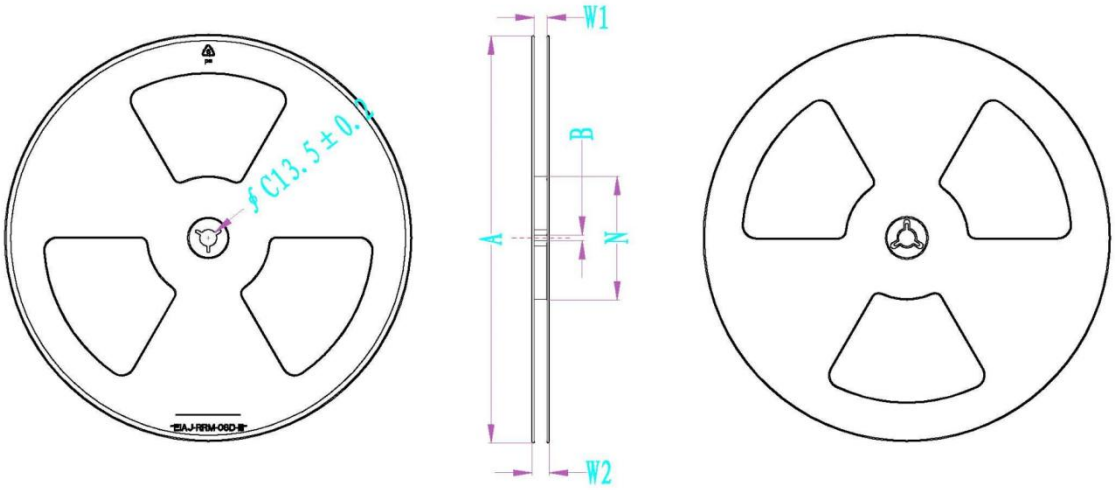
Symbol	Dimensions In Millimeters			Symbol	Dimensions In Millimeters		
	Min	Nom	Max		Min	Nom	Max
A	0.70	0.75	0.80	b	0.18	0.23	0.28
A1	0.00	-	0.05	L	0.30	0.40	0.50
A3	0.2 REF			D2	2.30	2.45	2.55
D	2.95	3.00	3.05	E2	1.50	1.65	1.75
E	2.95	3.00	3.05	e	0.50 BSC		

TAPE AND REEL INFORMATION

TAPE DIMENSIONS: DFN3x3-10



REEL DIMENSIONS: DFN3x3-10



Unit: mm

Ø A	Ø C	B	W1	W2	N
330±1.0	13.5±0.2	4.7±0.5	13.4±0.5	17.4±0.5	100±0.5

Note:

1) All Dimensions are in Millimeter
2) Quantity of Units per Reel is 5000
3) MSL level is level 3.

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